

DEUTERIUM RETENTION IN TUNGSTEN AND TUNGSTEN CARBIDES IRRADIATED WITH D IONS¹

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Depth profiles of D atoms and D₂ molecules in mono- and polycrystalline W as well as chemical vapor deposited (CVD) tungsten carbides W₂C and WC implanted with 6-10 keV D ions at 300 and 650 K have been determined using secondary ion mass spectrometry and residual gas analysis measurements in the course of surface sputtering.

In pure W samples implanted at 300 K deuterium is retained as D atoms both in the ion stopping zone and at depths up to 2 μm. Besides, in the stopping zone deuterium is additionally accumulated in the form of D₂ molecules. After D ion implantation at 650 K the D₂ molecules are not observed in the W samples and deuterium is trapped in the form of D atoms alone in the implantation zone. In the stopping zone of W crystal irradiated at 300 K the maximum concentration of deuterium accumulated in both states reaches value of $\sim 8 \times 10^{-2}$ D/W. After irradiation at 650 K this value is found to be $\sim 1.5 \times 10^{-2}$ D/W.

As differentiated from pure W, in the CVD samples irradiated with D ions at 300 K deuterium is not accumulated in the form of D₂ molecules. Most of the D atoms implanted into the CVD tungsten carbides at 300 K diffuse far deep into the bulk and are accumulated far beyond the implantation zone. At 650 K the D atoms are captured within the implantation zone. In the stopping zone of CVD W₂C and WC carbides implanted at 300 and 650 K the maximum concentration of D atoms does not depend practically on type of carbide and reaches value of $\sim 3.2 \times 10^{-2}$ and $\sim 1 \times 10^{-2}$ D/W, respectively.

There are at least two types of ion-induced defects which are responsible for trapping of D in pure W: (i) D₂ filled microvoids localized in the implantation zone and (ii) dislocations which are distributed from the surface to depths far beyond 1 μm and capture deuterium in the form of D atoms. Additionally, D atoms can be trapped by vacancies and adsorbed on bubble walls. In CVD tungsten carbides the D atoms are captured also by intrinsic defects.

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